(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 August 2001 (02.08.2001)

PCT

(10) International Publication Number
WO 01/54980 A1

(51) International Patent Classification[7]: B64D 45/02

(21) International Application Number: PCT/GB01/00126

(22) International Filing Date: 12 January 2001 (12.01.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0001549.5 25 January 2000 (25.01.2000) GB

(71) Applicant *(for all designated States except US)*: **BAE SYSTEMS PLC** [GB/GB]; Warwick House, P.O. Box 87, Farnborough Aerospace Centre, Farnborough, Hampshire GU14 6YU (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SILLENCE, Colin, David** [GB/GB]; 15 Lyndale Avenue, Stoke Bishop, Bristol BS9 1BS (GB). **JONES, Christopher, Charles, Rawlinson** [GB/GB]; 173 St. Andrews Road South, St. Annes, Lancashire FY8 1YB (GB).

(74) Agent: **FLETCHER WATTS, Susan, Jane**; BAE Systems plc, Group IP Dept., Lancaster House, P.O. Box 87, Farnborough Aerospace Centre, Farnborough, Hampshire GU14 6YU (GB).

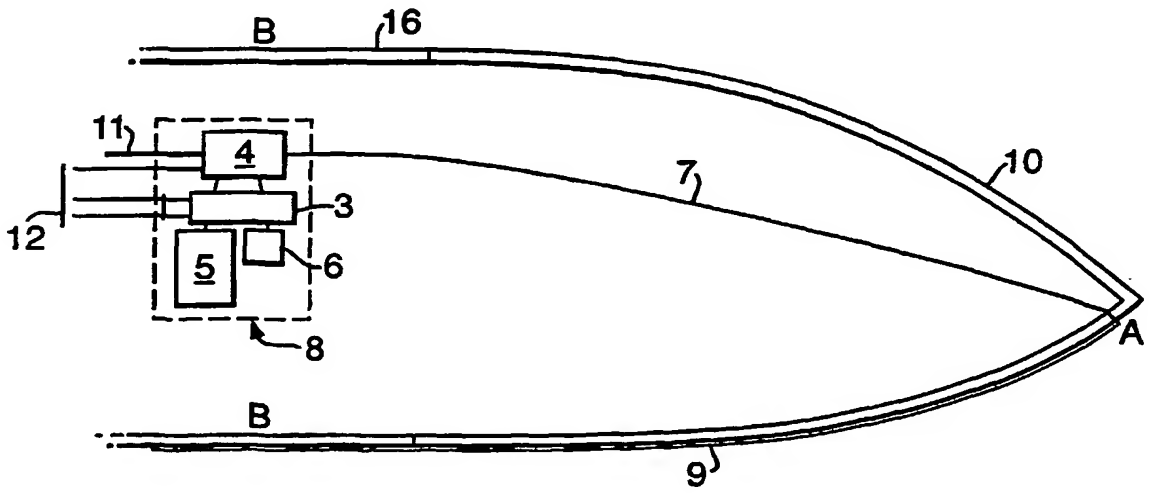
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: LIGHTNING PROTECTION APPARATUS AND METHOD



(57) Abstract: A deployable lightning protection apparatus particularly suited for use with an aircraft radome comprises; a source of electrically conducting fluid (5); a delivery means (3, 4, 7) for delivering the conducting fluid to the surface of the radome prior to a lightning strike; a control means (1, 2) for controlling the delivery means; and means for directing the conducting fluid across the outer surface of the radome thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current without damage to the radome. The apparatus allows lightning protection to be deployed in response to a change in atmospheric conditions indicative of a high probability of lightning strike and removed when the danger of lightning strike has passed.

WO 01/54980 A1

LIGHTNING PROTECTION APPARATUS AND METHOD

This invention relates to lightning protection apparatus and in particular but not limited to lightning protection apparatus for radomes.

It is well known that electric fields distort around sharp points causing a concentration of field strength about such points. As a consequence of this, sharp extremities on tall buildings and air borne vehicles are particularly prone to being struck by lightning in a storm. This is a particular problem for aircraft which, in order to be more aerodynamic, often incorporate sharply radiused projections. One example of such a sharply radiused projection is the radome which is generally fitted to the nose of an aircraft.

The radome generally carries the radar system and other electro-magnetically sensitive equipment and is by necessity made from a dielectric material, consequently a lightning strike to the radome can result in disintegration of the radome and subsequent in loss of the aircraft through aerodynamic instability. Thus, aircraft are provided with lightning protection systems to limit the damage which may be caused in the event of a lightning strike to the radome.

Conventional protection systems are known as lightning diverters. These generally consist of metal strips extending from the tip of the radome, across its external surface and back towards the metal airframe of the aircraft. When lightning strikes the radome, the current is carried by the conducting strips to the metal airframe where higher current densities can be safely dissipated. More recent variations comprise what is known as a button strip. This consists of a row of closely spaced metal dots carried on a strip of dielectric material. Just prior to a lightning strike, the atmospheric electric charge surrounding the aircraft builds, the dielectric begins to ionise, thus initiating the electrostatic ionisation of surrounding air molecules. The metal dots increase their local field strength and form a plasma thus providing a conductive channel for conducting the current induced by the lightning.

During lightning strike the small quantities of metals used in these conductors are subject to extreme temperatures and electro-dynamic forces which tend to cause them to ablate. As a consequence, these systems have a "one strike" capability and must be replaced on landing.

A further problem with these conventional technologies is that they require the presence of metal on the radome at all times, irrespective of atmospheric conditions. The conductive properties of this metal can cause serious aberration of radar system radiation patterns, with consequent degradation in the system's performance.

The present invention provides a lightning protection apparatus for a radome comprising;

a source of electrically conducting fluid;

a delivery means for delivering the conducting fluid to the surface of the radome prior to a lightning strike;

a control means for controlling the delivery system; and

means for directing the conducting fluid across the outer surface of the radome thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current without damage to the radome.

The provision of the electrically conductive medium in a fluid form permits a flexible system whereby the lightning conductive element can be deployed as and when atmospheric conditions are such that there is a significant risk that lightning may strike. The control means monitors the atmospheric condition and initiates delivery of the conductive fluid through the delivery means to the surface of the radome when a change indicative of a high probability lightning strike is detected.

Airflow over the radome surface during flight is sufficient to carry the conductive fluid across the radome surface and direct it towards the airframe thus providing a channel for conducting any current induced by a lightning strike to the airframe for dissipation. When conditions are such that there is no significant danger of lightning strike, the conductive fluid can be removed from the radome surface. When lightning protection is not needed, the conductive fluid can be stored in an insulating container thereby removing the conductive interference from the radar system and any consequent degradation of radar performance.

The control means will generally comprise a series of sensors for detecting changes in the atmosphere associated with imminent lightning. These sensors may detect factors such as changes in light levels, temperature, humidity and the like but most preferably detect changes in electrostatic field strength. Preferably, threshold sensors are also incorporated into the control means for recognising when the field strength has exceeded a predetermined level indicative of a high probability of lightning strike. The control means may additionally incorporate software for controlling the delivery and removal of the fluid. Typically, a predetermined threshold level would be in the region of 1000 volts per metre.

In some circumstances, aircraft are known to accumulate electrostatic charge in the course of flight in relatively stable weather conditions. In these circumstances the polarity of the E-field over the entire surface of the aircraft will be the same (i.e. either directed outward from the surface, or inward towards the surface at all points). In a high probability of lightning strike atmosphere, the polarity of the E-field at the aircraft surface will vary over the surface, being outward in some regions, and inward in others. Thus, in order to better discriminate high probability lightning strike conditions from strong E-fields due to other phenomena, it is preferred that the control means incorporate a means for detecting localised polarity of E-fields at the aircraft surface.

In some embodiments of the invention, this is achieved by providing a plurality of polarity sensitive electrostatic field sensors located at diverse positions on the aircraft surface, preferably in a circumferential spatial arrangement about the longitudinal axis of the radome. It is advantageous to sample the field at surfaces facing upward, downward, left, right, forward and backward. Suitable electrostatic and polarity sensitive sensors include integrated optics E-field sensors such as those which utilise Pockel's or Kerr's electro-optical effects in materials such as Lithium Niobate. A logic circuit is also incorporated which is configured to recognise a condition where at least one electrostatic sensor detects a field amplitude which exceeds the predetermined threshold level and the polarity of the field detected by each of the plurality of electrostatic field sensors is not the same. When this condition is recognised, the logic circuit activates the delivery system by any suitable switching mechanism.

Whilst airflow is sufficient to direct the conductive fluid across the radome, it may be preferable to provide some form of guide in the surface of the radome to enable the conductive fluid to travel consistently in the same path. Such a guide may conveniently be provided in the form of a shallow groove on the surface of the radome.

Once the threat of a lightning strike has passed, it is desirable to remove the conductive channel from the radome surface. Again, once the delivery means has ceased delivery of the fluid, air flow can be used to remove the fluid from the surface. Preferably, the apparatus will comprise features specifically designed to remove the fluid. In one option, such a feature may comprise a source of clean carrier liquid and means for flushing the clean carrier liquid through the delivery system and over the conductive channel thereby removing the conductive channel. The control means can be configured to recognise changes in the surrounding atmosphere indicative of a reversion from a high probability of lightning strike condition back to a normal condition.

The delivery means itself may comprise any suitable form but conveniently comprises two or more dialectric capillary tubes which vent close to the tip of the radome and a pump and valve arrangement associated with a reservoir of the conducting fluid for pumping fluid into the capillary tubes. The delivery system is conveniently operated by a pneumatic or hydraulic system and should be electrically and spatially isolated from the conducting airframes or anything electrically connected to us, in order to prevent lightning striking the aircraft via a path inside the radome. This may conveniently be achieved by operation via a pneumatic or hydraulic system, employing non-electrically conducting pipes and fluids. Alternatively, the delivery means may be operated by electric pump and valve means powered by a local battery and the control means comprises a signalling circuit of optical fibres.

Where a pump is used to deliver the conductive fluid, the pump may have a reversible action so that the fluid can be withdrawn back into the reservoir when the threat of lightning is removed.

Suitable fluids for use as the conductive fluid include any dielectric carrier loaded with conducting particles. For example distilled water carrying carbon particles. Additives which may optionally be added to improve performance include, wetting agents, anti-blockage agents which separate particles to prevent blockage of delivery tubes and orifices, additives for reducing the evaporation temperature or rate of evaporation of the fluid and anti-static or anti-cling agents to minimise adherence of conductive particles after delivery. Alternative fluids include conductive gases or particulates of conductive material such as mercury vapour or carbon smoke.

In another aspect, the present invention provides a method for conducting lightning across the surface of a non-conducting article comprising;

providing a source of electrically conducting fluid;

delivering the conducting fluid to the surface of the article prior to a lightning strike; and

directing the conducting fluid across the outer surface of the article thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current through a conductive medium.

For the purposes of exemplification, some embodiments of the invention will now be described with reference to the Figures in which:

Figure 1 shows a schematic flow chart of one embodiment of the inventive system.

Figure 2 illustrates a pneumatically operated embodiment of the invention.
Figure 3 illustrates an electrically operated embodiment of the invention.

Figure 4 illustrates the control system for the embodiment of Figure 2.

Figure 5 illustrates the control system for the embodiment of Figure 3.

As can be seen from Figure 1, a system of electrostatic sensors indicated generally by reference numeral 1 provide input to a control system 2 which comprises a threshold sensor and a simple logic circuit. When the logic circuit detects conditions indicative of a high probability of lightning strike, it communicates this to the pump 4 and valves 3 of the delivery system 7, 8. Conducting fluid from a reservoir 5 is transported through valve means 3 and pump 4 to a system of capillary tubes 7 which vent at various points near the tip of the radome. On deployment of the conducting fluid, as the aircraft is in flight, airflow drags the delivered conducting fluid in a direction opposing the direction of travel of the aircraft across the radome surface and towards the metal airframe.

In the particular embodiment shown, a second reservoir 6 of clean carrier fluid is provided. The control system is configured to detect a reversing of conditions to below the threshold value. When this condition is recognised the control system communicates this to the valves 3 which switch to allow release of the clean carrier fluid over the radome surface thereby removing the conductive path. To prevent lightning current being conducted internally to the radome, the conductive fluid reservoir 5, valves 3 and pump 4 are encased in a dielectric container 8, the capillary tubes 7 are also made from an insulating material.

Figure 2 illustrates an embodiment similar to that of Figure 1 incorporated into the nose portion of an aircraft. As can be seen from the Figure, a capillary tube 7 vents at a point A near to the tip of the radar transparent radome 10 of the aircraft. When a high probability of lightning strike is detected, the conductive fluid is pumped from the reservoir 5 via the valves 3 and pump 4 to the capillary tube 7 which is one of a number of similar tubes. Due to the geometry of the aircraft nose cone and airflow during flight, the fluid travels along the bottom surface of the radome towards the metal airframe 16 creating a conductive channel 9 leading from the tip of the radome A to a point B on the conductive airframe 16. A supply of pressurised air is provided via a dielectric pipe 11 to drive the pneumatic pump 4. Additional dielectric pipe work 12 carry hydraulic or pneumatic fluid controlled by the logic circuit to activate the delivery system when a high probability of lightning strike is detected.

The embodiment shown in Figure 3 operates in essentially the same manner as that described in relation to Figure 2, however, in this embodiment, the control system is operated by opto-electric rather than hydraulic and pneumatic means. A battery 14, contained in dielectric container 8 powers the pump 4 and valves 3. Information from and to the logic circuit is relayed via signals through optical fibres 15.

Figures 4 and 5 show the basic circuitry for the sensor system. Figure 4 relates to the embodiment shown in Figure 2 and Figure 5 relates to the embodiment shown in

Figure 3. An E-field sensor 21 detects a charge in the surrounding E-field and relays a signal to an amplifier 22. The signal is processed through a low pass filter 23 and to a comparator 24 where it is compared against a voltage reference 25. Preferably the comparator circuit incorporates a polarity identifier. Simultaneously other signals are relayed by other sensors 21a, 21b, 21c, 21d through similar circuits. The comparators 24 relay the signal to the threshold detector 2 and logic circuit for processing.

Whilst the foregoing embodiments describe the invention for use in relation to a radome on an aircraft, the skilled person will understand that the invention is not limited to these embodiments. The basic principle behind the invention, that is, the use of a deployable fluid conductor in place of a permanent solid conductor, may be used to replace conventional lightning conductors in numerous other applications.

CLAIMS

1. A lightning protection apparatus for a radome comprises;

a source of electrically conducting fluid;

a delivery means for delivering the conducting fluid to the surface of the radome prior to a lightning strike;

a control means for controlling the delivery means; and

means for directing the conducting fluid across the outer surface of the radome thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current without damage to the radome.

2. A lightning protection apparatus for a radome as claimed in claim 1 wherein the control means comprises;

means for detecting a change in surrounding atmospheric conditions indicative of a high probability lightning strike; and

means for initiating delivery of the conducting fluid on detection of such a change in atmospheric conditions.

3. A lightning protection apparatus for a radome as claimed in claim 2 wherein the means for detecting a change in atmospheric conditions comprises one or more electrostatic field sensors and the means for initiating delivery comprises a threshold detector for detecting when an electrostatic field amplitude detected by the one or more electrostatic field sensors exceeds a predetermined threshold level, and a switch for activating the delivery means when the predetermined threshold level is exceeded.

4. A lightning protection apparatus for a radome as claimed in claim 3 wherein a plurality of electrostatic field sensors are provided in a circumferential spatial arrangement about the longitudinal axis of the radome and are polarity sensitive; the means for initiating the delivery system comprises a logic circuit configured to recognise a condition where at least one electrostatic sensor detects a field amplitude which exceeds the predetermined threshold level and the polarity of the field detected by each of the plurality of electrostatic field sensors is not the same, and the switch is activated by the logic circuit only when both these conditions are met.

5. A lightning protection apparatus for a radome as claimed in claim 3 or claim 4 wherein the predetermined threshold level is about 1000 volts per metre.

6. A lightning protection apparatus for a radome as claimed in any preceding claim wherein the means for directing the conducting fluid across the outer surface of the radome comprises grooves on the surface of the radome.

7. A lightning protection apparatus for a radome as claimed in any preceding claim further comprising means for deactivating the conductive channel when the surrounding atmospheric conditions are no longer indicative of a high probability lightning strike.

8. A lightning protection apparatus for a radome as claimed in claim 7 wherein the means for deactivating the conductive channel comprises a source of clean carrier liquid and means for flushing the clean carrier liquid through the delivery system and over the conductive channel thereby removing the conductive channel.

9. A lightning protection apparatus for a radome as claimed in any preceding claim wherein the delivery system comprises two or more dialectric capillary tubes which

vent close to the tip of the radome and a pump associated with a reservoir of the conducting fluid.

10. A lightning protection apparatus for a radome as claimed in any preceding claim wherein the delivery system comprises a pneumatic or hydraulic system in which all control lines are dielectric and the pneumatic or hydraulic fluid used is not electrically conducting.

11. A lightning protection apparatus for a radome as claimed in any one of claims 1 to 9 wherein the delivery means comprises electric pump and valve means powered by a battery and the control means comprises a signalling circuit of optical fibres.

12. A lightning protection apparatus for a radome as claimed in any one of claims 9 to11 wherein the pump has a forward action for delivering the conductive fluid to the surface of the radome and a reverse action for withdrawing it from the surface of the radome.

13. A lightning protection apparatus for a non-conducting article comprising;

a source of electrically conducting fluid;

a delivery means for delivering the conducting fluid to the surface of the article prior to a lightning strike;

a control means for controlling the delivery system; and

means for directing the conducting fluid across the outer surface of the article thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current through a conductive medium.

14. A method for conducting lightning across the surface of a non-conducting article comprising;

providing a source of electrically conducting fluid;

delivering the conducting fluid to the surface of the article prior to a lightning strike; and

directing the conducting fluid across the outer surface of the article thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current through a conductive medium.

15. A lightning protection apparatus substantially as described herein and with reference to the Figures.

16. A method for conducting lightning across the surface of a non-conducting article substantially as described herein and with reference to the Figures.

Fig.1.

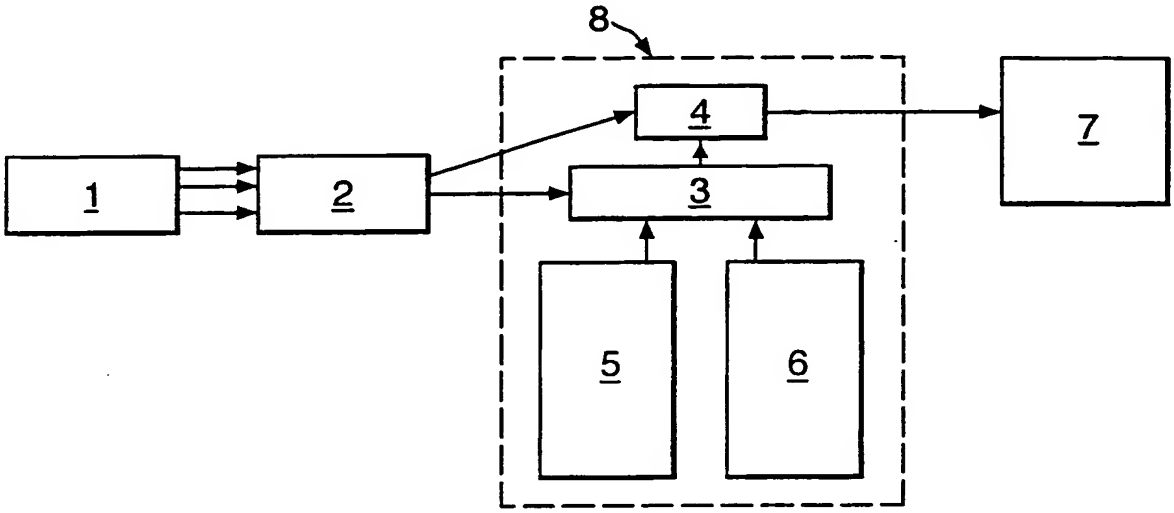


Fig.2.

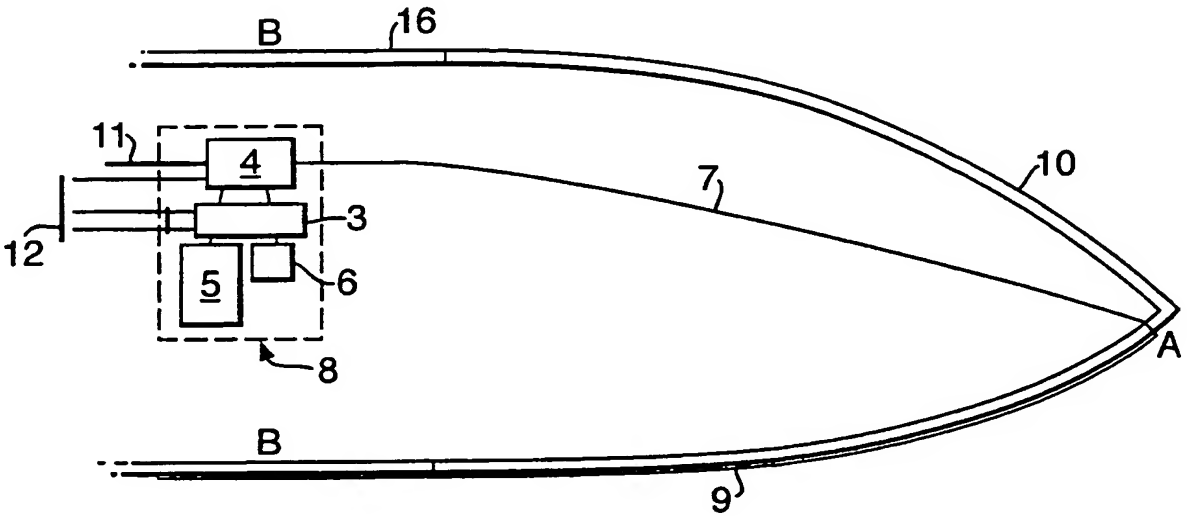


Fig.3.

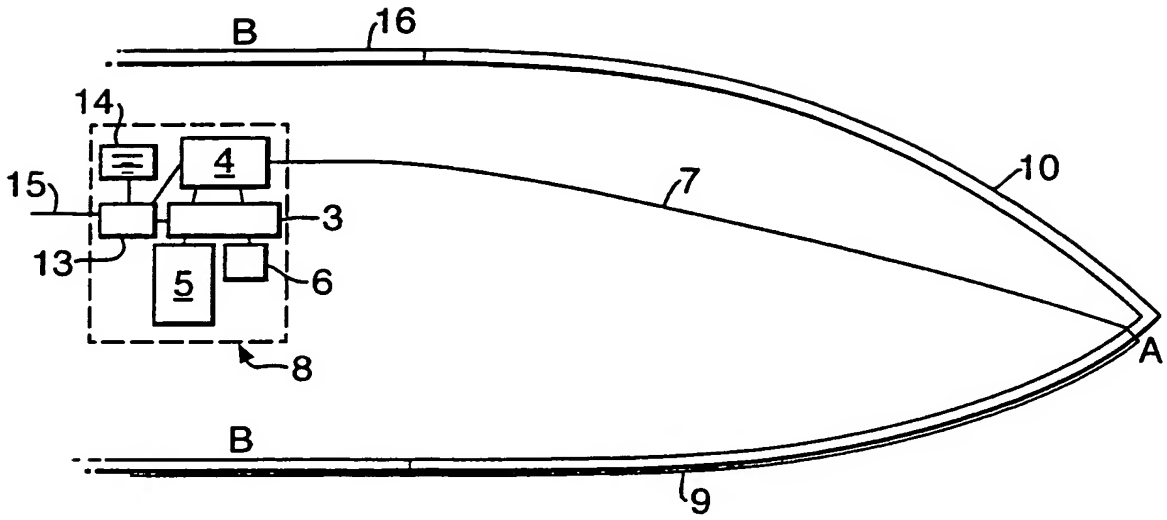

B
16
14
4
15
7
10
3
13
5
6
8
A
B
9

Fig.4.

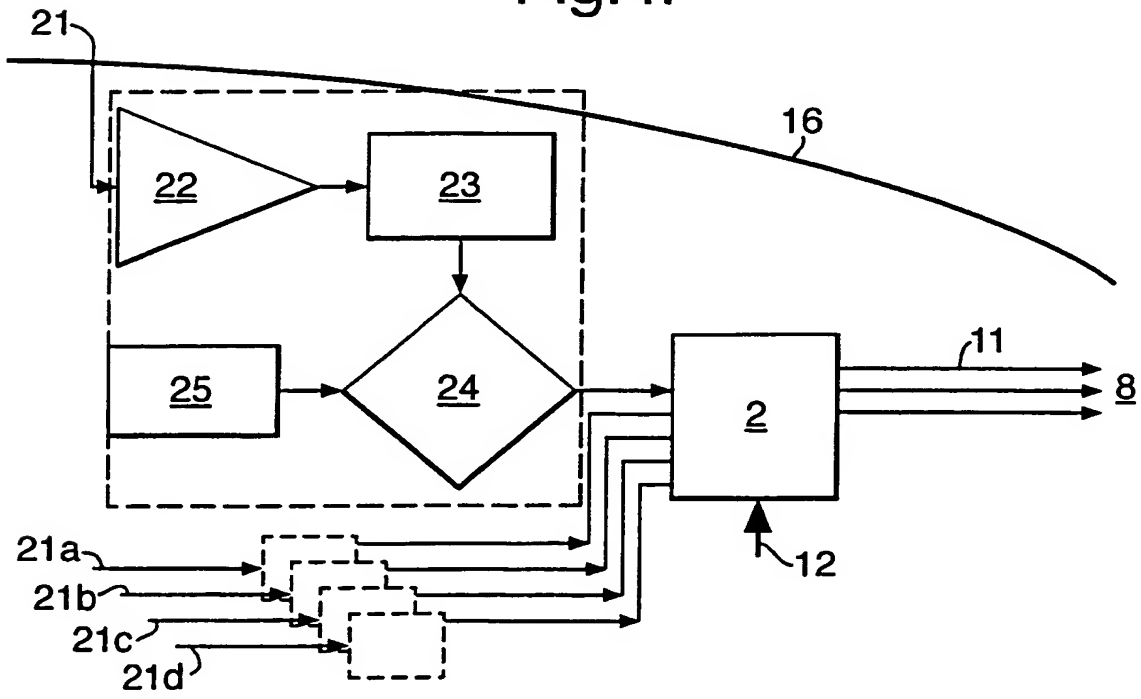
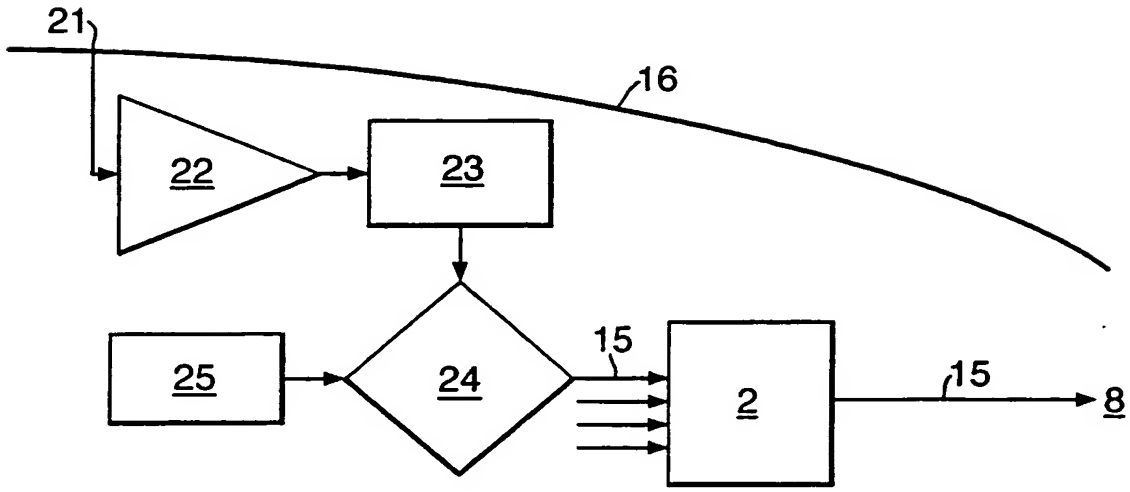

21
16
22
23
25
24
2
11
8
12
21a
21b
21c
21d

Fig.5.



PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 12 September 2001 (12.09.01)	
International application No. PCT/GB01/00126	**Applicant's or agent's file reference** XA1266
International filing date (day/month/year) 12 January 2001 (12.01.01)	**Priority date** (day/month/year) 25 January 2000 (25.01.00)
Applicant SILLENCE, Colin, David et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

01 August 2001 (01.08.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Pascal Piriou
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

GB0100126

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
XA1266		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB01/00126	12/01/2001	25/01/2000
International Patent Classification (IPC) or national classification and IPC B64D45/02		
Applicant BAE SYSTEMS plc et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 7 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
01/08/2001	20.02.2002
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Salentiny, G Telephone No. +49 89 2399 8337

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB01/00126

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1,4,7,8	as originally filed			
2,3,5,6	as received on	22/01/2002	with letter of	03/01/2002

Claims, No.:

1-13	as received on	22/01/2002	with letter of	03/01/2002

Drawings, sheets:

1/5-5/5	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-13
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-13
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-13
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

Reference is made to the following document cited in the search report :

D1: US-A-4 323 946 (Robert L. Traux, 6 April 1982)

V. Reasoned Statement under Art. 35(2) with regard to novelty, inventive step or industrial applicability

The document D1 is regarded as being the closest prior art to the subject-matter of the independent product claim 1. This document discloses an apparatus for discharging dielectric surfaces by means of conductors applied to these surfaces. To achieve this purpose, D1 proposes in one of the embodiments shown to flood the charged area with a conductive flowing fluid. The control of the fluid delivery is achieved by sensor means which detect the charging level of the dielectric surface. D1 proposes furthermore to use these devices to discourage lightning strikes.

Departing from the teachings of D1, claim 1 proposes :

- to use electrostatic field sensors for detecting a change in surrounding atmospheric conditions indicative of a high probability lightning strike
  and
- to deliver the conductive fluid to the surface upon an electrostatic field amplitude threshold value sensed by the field sensors, said fluid delivery being capable of conducting any current induced by a lightning strike to the airframe for dissipation.

The document D1, although mentioning the use of the proposed system for avoiding lightning strikes, does not identify its system as being suitable for providing a channel for conducting the current induced in the event of a lightning strike. The system as proposed in claim 1 however has to be able to handle very high current levels which again require higher conductive fluid flow rates. It is therefore important in order to reduce fluid consumption to use an accurate system for detecting the danger of imminent lightning strikes and to initiate the fluid delivery only in case a certain danger threshold is exceeded. For this purpose, claim 1 proposes to use electrostatic field sensors which detect a change in the surrounding atmospheric conditions.
Claim 1 thus proposes a system for dissipating the current induced by a lightning strike whereas the system of D1 proposes a system to avoid lightning strikes.

There is no suggestion to be found, neither in D1, nor in any other document cited in the search report, which would guide the skilled man in a straightforward manner to the claimed subject-matter.

The subject-matter of claim 1 is therefore new in the sense of Article 33(2) PCT and is also considered as involving an inventive step in the sense of Article 33(3) PCT.

Claims 2-10 are dependent on claim 1 and as such do also meet the requirements of the PCT with respect to novelty and inventive step.

The independent method claim 11 defines the subject-matter of claim 1 in terms of corresponding method steps. Claim 11 is therefore also new in the sense of Article 33(2) PCT and is also considered as involving an inventive step in the sense of Article 33(3) PCT.

VII. Certain defects in the international application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Claims 12 and 13 contain references to the description and/or the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
XA1266		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 01/00126	12/01/2001	25/01/2000
Applicant		
BAE SYSTEMS plc		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 2

[ ] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[X] because this figure better characterizes the invention.

[ ] None of the figures.